

Approach to Training of Personnel to Manage Radioactive Wastes Offered by Education Training Centre at Moscow Sia «Radon» Under Sponsorship of Iaea

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ABSTRACT

The availability of qualified personnel is crucial to the licensing and efficient and safe operation of waste management facilities and for the improvement of the existing waste management practices. The countries with some degree of waste management activities are of special concerns, since their narrow waste management experience and personal capabilities may be a limiting factor to manage radioactive waste in a safe and technically optimal manner. The International Education Training Centre (IETC) at Moscow State Unitary Enterprise Scientific and Industrial Association “Radon” (SIA “Radon”), in co-operation with the International Atomic Energy Agency (IAEA), has developed expertise and provided training to waste management personnel for the last 10 years. During this period, more than 300 specialists from 26 European and Asian countries, (mostly) sponsored by the IAEA, have increased their knowledge and skills in radioactive waste management. The current experience of the SIA “Radon” in the organisation of the IAEA sponsored training is summarized and an outline of some strategic educational elements, which IETC will continue to pursue in the coming years, is provided.

INTRODUCTION

The overall objective of radioactive waste management (RWM) is to ensure protection of the human health and the environment, now and in the future, and without imposing undue burden on future generations. The RWM includes handling, pretreatment, treatment, conditioning, storage, transportation and disposal of conditioned radioactive waste, as well as release of decontaminated materials and controlled discharges of effluents. The identified objective can be met with reasonable cost and resources by implementing a carefully planned waste management strategy and by using appropriate technologies.

The waste management strategy of many countries, in particular those of the former Soviet Union, envisages that the wastes from a variety of producers would be transported to the central

waste management facility, where a relevant level of safety for subsequent processing and conditioning of wastes for the disposal could be ensured. The implementation strategy assumes that at such facilities the necessary expertise, installations and quality assurance would exist, so that safe and modern waste processing technologies could be implemented. The additional assumption is that the regulatory body of jurisdiction would have expertise and resources to ensure that the central facility has all necessary equipment for safe waste processing and that it is operated by qualified personnel in accordance with established requirements.

The adequate training for regulators, operational staff and others involved in licensing, operation or upgrading of the existing radioactive waste management facilities is a question of the highest priority in the countries of the former USSR, especially due to the fact that the centralized system, which existed for training and education of the regulators and operators of the regional waste management facilities, has been practically lost.

Recognizing the increasing importance of the subject of the human resource capability development the International Atomic Energy Agency (IAEA) assists the Member States of the former USSR in training and enhancing qualification of the specialists required for licensing or operation of the central radioactive waste management facilities.

The availability of qualified personnel is crucial to the licensing and efficient and safe operation of waste management facilities and for the improvement of the existing waste management practices. The countries with some degree of waste management activities are of special concerns, since their narrow waste management experience and personal capabilities may be a limiting factor to manage radioactive waste in a safe and technically optimal manner.

In the Russian Federation extensive education and training activities are carried out by the International Education Training Centre (IETC) at Moscow State Unitary Enterprise Scientific and Industrial Association "Radon" (SIA "Radon").

IETC AT SIA "RADON"

Moscow SIA "Radon" started its activity in 1961. SIA "Radon" is the main organisation of the Regional system for radioactive waste management from non-nuclear applications (e.g. medicine, industry, agriculture, scientific researches and others) in the Russian Federation. Its service area covers the city of Moscow and Moscow region and additionally other ten neighbouring regions of the Central part of the Russian Federation. The SIA "Radon" is responsible for radiation safety of the most industrially developed domain of the Russian Federation, with almost 40 million inhabitants. [1].

The SIA RADON is a unique organization, which focus on applied research and development of technologies for safe radioactive waste management, and utilization of these technologies in every day operation of its centralized processing and long term storage facilities. The processing facilities process 2000 m³ of institutional L&IL radioactive waste per year. The long-term storage complex for low and intermediate level institutional waste has a total capacity of stored waste of 2.10⁵ m³.

The SIA "Radon" developed and utilized variety of technologies and techniques used for pretreatment, treatment and conditioning of radioactive waste prior to the disposal, such as segregation and sorting of the waste streams, incineration of the solid and liquid low level waste (classic incineration and innovative plasma arc incineration), ash residue plasma melting,

vitrification of the low and intermediate level waste, thermo-chemical treatment of spent ion exchange resins, and of reactor graphite waste containing C-14, compaction of the waste, electrokinetic purification of soil locally contaminated with radionuclides or heavy metals, conditioning of silts contaminated with radioactive and other toxic substances, thermo-chemical decontamination of local pollutions, liquid waste processing by mobile plant, immobilization of the long lived spent radioactive sources into metal matrices, cementation and other technologies for radioactive waste conditioning technologies for long-term storage/disposal.

The education service for specialists dealing with radioactive waste was established in Russia (former USSR) in 1983 and was based on the capabilities of two organisations: 1) the Moscow SIA «Radon» and 2) the Chemical Department of Lomonosov's Moscow State University. These two organizations are able to offer training programs in the science fundamentals, applied research and in practical operational areas of the all pre-disposal activities of the radioactive waste management. Training courses for the specialists of the regional centralised radioactive waste facilities "Radon", the new personal of Moscow SIA "Radon" and specialists from other organizations which work with radioactive materials are held every year. About 550 individuals have received training certificates since the courses were established.

At the beginning 1997 this system was upgraded to the international level and now acts as a dedicated training centre, the IETC, under the guidance and sponsorship of the IAEA [2]. The organisation structure of IETC is shown on the Figure1.

The IETC has three sections that are dealing with the training. The main objective of the **Section 1** is to: develop and maintain training methodology in accordance with State policy and strategy for the radioactive waste management; provide for solution of scientific-technical tasks dealing with educational process; improve the quality of training by improving qualification of teachers and instructors, provide criteria for measurement of training efficiency, and prepare technical manuals and guidance documents, other training materials, training and learning programme plans.

The main objective of the **Section 2** is management of: training technology; information and communications with partners; monitoring of training processes; organisation and implementation of training activities (scientific visits, workshops, fellowships) and technical meetings for the exchange of information in current technological developments on radioactive waste management on general and individual programs; feedback of the participants, corporate database and maintenance of IETC positive image.

The main objective of the **Section 3** is to: organise and implement practice and demonstrations of methods and procedures for the radioactive waste management training; provide for QA/QC; maintain the documentation; and maintenance of radiation control devices.

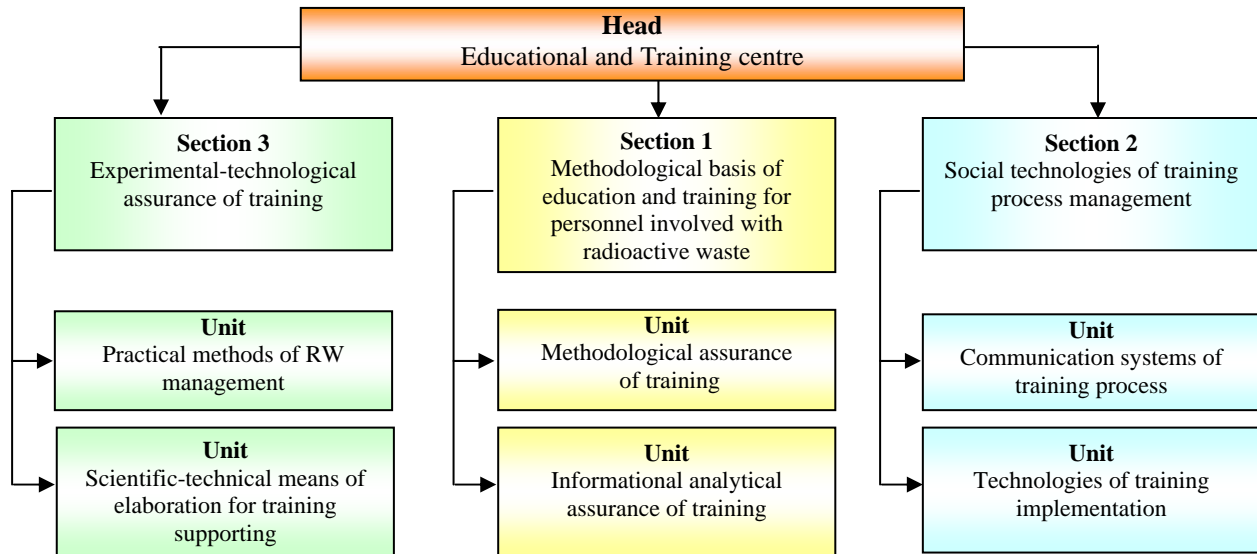


Fig.1. Organisational structure of IETC

IETC at Moscow SIA “Radon”, in co-operation with the IAEA, has developed expertise and provided training to waste management personnel for the last 10 years. IETC activities were previously described in WM Conference proceeding in 1999, 2002 and in 2006 [3-6].

During this period more than 300 specialists from 26 European and Asian countries, (mostly) sponsored by IAEA, have increased their knowledge and skills in radioactive waste management (Figure 2).

SIA “RADON” TRAINING APPROACH

Technological and operational aspects of the radioactive waste management are inseparably linked with questions on occupational, public and environmental safety. The IAEA has published many documents on both safety and technological aspects of the radioactive waste management providing synthesis of international practices, lessons learned, requirements and guidelines for implementation of the best practices. The IAEA, also, provides variety of different training programs to improve the qualification of specialists involved in radioactive waste management activities.

The training provided by IETC, applies various approaches to the transfer of sound waste management experience to individuals sponsored by the IAEA – and thereby is helping to strengthen personal capabilities in the Member States in the field of radioactive management. The IAEA sponsored specialized regional training courses and workshops, fellowships for on-the-job training and scientific visits are additional means to assure development of personnel capabilities required.

It is important to study training efficiency and quality of particular training components, in forming of the complex technological training process [4]. The quantitative assessment of personnel training efficiency was described in reference [6]. Partition of training activities into

particular interacting stages is fundamental to the systematic approach to training, which has been regarded as a main methodological conception, reported in references [7-9].

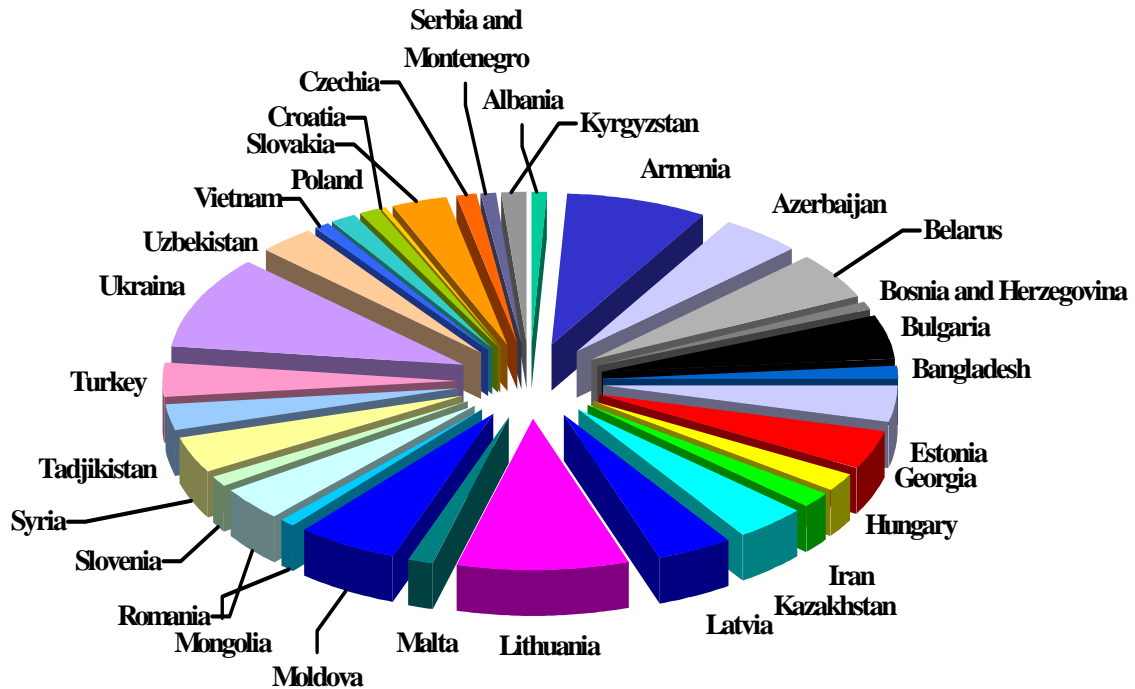


Fig.2. Member States involved in IETC training activities sponsored by IAEA

Main training activities

Till recently the specialized regional training events were held by providing training under two general modules, each designed with the specific objectives and directed at the different audience.

The main objective of the *first module* was to develop technological skills of operators of the waste management facilities by demonstration of modern methods and procedures for the waste management. The module includes both theoretical and practical classes. Participants were provided with the opportunity to work with radioactive waste in the real operating conditions. All demonstrations were conducted in full consistence with the relevant IAEA Safety Standards and other international requirements.

The Workshop on “Treatment, conditioning storage and disposal of spend sealed radioactive sources” under IAEA Regional TC Project “Quality Management of Radioactive Waste in Central and Eastern Europe” was organised at IETC under auspices of the IAEA in May 2006. 21 attendees from 15 Member-States participated in discussion on the spend sealed radioactive sources (SRS) management. The purpose of the Workshop was to discuss methodologies, technologies and advanced practices for managing of SRS at centralised facilities. This included inventories, classification and characteristics of sealed sources, areas of their applications, identification of unknown sources, potential hazards associated with handling, processing and storage of SRS, conditioning of sources for long term storage and disposal. The importance of safe management of SRS as radioactive waste for protection of human health and environmental

has been recognized and considerable experience and lessons learned in the Member States were shared during the workshop. It was concluded that the technical knowledge and expertise is a necessary prerequisite for safe and cost-effective management of such specific radioactive waste.

The main objective of the *second training module* was specific to specialists, involved in the development and the implementation of long-term safety assessment methodology for near-surface disposal facilities (ISAM). The participants represented Regulatory Bodies, operators, scientific and research organizations.

In June 2006 Workshop on “National Strategies for the Safety of Radioactive Waste Management and the Safety Case concept for Demonstrating the Safety and Licensing of Waste Management Facilities and Activities” under IAEA Regional TC Project “Safety Assessment and Licensing of predisposal radioactive waste management facilities and activities” was organised at IETC under auspices of the IAEA for 15 participants from 12 Member-States. The purpose of the Workshop was to discuss the points such as “Global safety regime for safety in radioactive waste management”; “IAEA safety standards and the Joint Convention”; national policy and strategies for radioactive waste management; national legal, institutional and regulatory infrastructure for safety of radioactive waste management and safety requirements for near surface disposal of radioactive waste.

The new developments in SIA “Radon” training activity

The first experience with the Training Programme which was a deliberate *mix of the two earlier modules* took place in June 2006, when the IETC hosted the IAEA “Regional Training Course on Radiation and Waste Safety for Operating Centralized Radioactive Waste Management Facilities”. This Regional Training Course was designed for participants from New Independent States operating centralized waste management facilities for processing and storage/disposal of low- and intermediate level radioactive waste. It was conducted within the framework of the IAEA Technical Co-operation Regional Project RER /09/79 on “Upgrading National Regulatory Infrastructure”, and supported by the IAEA Waste Safety and Waste Technology Sections. 23 individuals from 11 countries (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Tajikistan, Ukraine, Uzbekistan, and Estonia) participated in the course: 11 participants were from operating facilities, and 12 participants were from regulatory bodies.

The main objective of the training course was to provide fundamental knowledge and recent practical experience on the safe management of radioactive waste to the operators of centralized waste management facilities, in particular “Radon”-type facilities, as well as to the national regulatory bodies responsible for licensing and inspection of such facilities. The Regional Training Course programme covered wide aspects of waste management starting with classification and characterization of radioactive waste, identification of options for treatment and conditioning of liquid and solid waste, safe management of sealed radioactive sources, and ended with elaboration on safety requirements for storage, transportation and disposal of radioactive waste, record maintenance and for establishment of an integrated quality management systems.

The two-weeks programme of this training course consisted of (1) lectures on regulatory aspects on the radiation protection and safety requirements for the waste management process, including licensing and safety assessment methodologies for near-surface disposal facilities; (2) modern procedures for treatment of radioactive waste and practical exercises in handling of waste and in using radiation monitoring devices; (3) site visits to installations for waste processing, treatment

and conditioning; (4) presentations of participants on the national experience in operation, processing, storage and disposal of radioactive waste; (5) computer-based testing of participants' knowledge; and (6) panel discussions on a key issues identified in the frame of the training course subject. The programme of lectures, practice and demonstrations is given in Table 1.

Particular attention was given to the transfer of knowledge from the experienced Moscow RADON personnel to young individuals from the Member States, who needed to update and broaden their knowledge to either operate centralized waste management facilities or regulate these facilities through their national regulatory bodies. Qualified lecturers from the IAEA and NTEC (The Nuclear Technology Education Consortium, United Kingdom [10]) were also invited to give several lectures on generic and specialised topics.

Participants were required to provide information and reports analyzing their relevant country's/facility's experience on the following:

- Brief description of existing facilities and radioactive waste inventories;
- Licensing status of these facilities (e.g. license for storage) and safety basis for the license;
- Describe briefly the national regulatory framework for management of radioactive waste and disused sealed sources;
- Approach for regulatory evaluation
- Lessons learned from recent regulatory inspection;
- Challenges or problem areas for licensing or re-licensing of waste management facilities;
- Approach to safety assessment of existing facilities;
- Conditions of regulatory authorization and their establishment;
- Identification of areas where international assistance and guidance are needed.

Figure 3 shows some pictures from Training Course held at the IETC in June 2006.



a)



b)

Fig.3. IAEA Training Course in 2006: a) Discussion during the site visit to radiation control devices production company "DOZA" b) Presentation of the participant from Uzbekistan

Table I. Programme of two-weeks Regional Training Course on Radiation and Waste Safety for operating Centralized Radioactive Waste Management Facilities

Lecture (IAEA document)	Practice, Demonstration
<ul style="list-style-type: none"> • Global safety regime: IAEA safety standards and the Joint Convention • National Policy and Strategies for radioactive waste management (GS-R-1; WS-R-2; JC) • National Legal, Institutional and Regulatory Infrastructure for Safety of Radioactive Waste Management (GS-R-1) • Regulatory control of discharges and strategies for monitoring (WS-G-2.3) • Safety requirements for near surface disposal of radwaste (WS-R-1) • Radioactive waste classification, segregation and characterization. (SS 111-G-1.1) • Safety requirements for predisposal management of radioactive waste (WS-R-2; DS353) • The concepts of exemption, clearance, authorized discharge, recycling and reuse (RS-G-1.7) • Storage of radioactive waste (DS292) • Safety requirements for borehole disposal facilities (DS 335) • Safety requirements for handling and transport of radioactive waste (TS-R-1) • Management System for Radioactive Waste management and Disposal (Ds 337-339) • Principles of Safety Assessment. Safety assessment (re-assessment) of existing facilities • International experience in upgrading of Radon type waste disposal facilities. • Internationally accepted waste management principles and strategies – technological aspects. Integrated approach in waste management. • Collection, sorting and initial characterisation of waste. Acceptance requirements for waste processing. • Decontamination techniques. Selection of options and management of secondary waste. • Radiation control and dosimetry. • Options for processing (treatment) of liquid waste. Concentration or direct immobilization. • Treatment options for solid radioactive waste. Waste acceptance for particular treatment methods. • Waste immobilisation. Compatibility of waste with selected immobilisation technology. Waste acceptance criteria. • Specific approaches and requirements for management of biomedical radioactive waste. • Chemistry of cementation processes. Quality of immobilized waste • Advanced methods for treatment and conditioning of radioactive waste. • Organization of waste recovery, reconditioning and rehabilitation work at old storage and disposal facilities for radioactive waste. • Options for conditioning, extended storage and disposal of spent sealed radioactive sources. • Containers for waste collection, storage and transportation. 	<ul style="list-style-type: none"> • Technical tour to the facility • Perspective technology of RW treatment and scientific developments • Dosimetry demonstration • Standards, QC and QA • Decontamination • Record keeping: passport, labelling, databases • Collection, identification, sorting, and storage of spent sealed radioactive sources. Practical training <ul style="list-style-type: none"> - Identification and sorting - Packaging - Labelling - Radiation control - Handling heavy container • Calculation dose rate on packages • Site visit to company producing dosimeters and radiometric devices

ANALYSIS OF TRAINING EFFICIENCY

Effectiveness of training depends on many factors such as: selection of lecturers, selection of trainees, content of training programme and the balance between theoretical and practical exercises. For example, the analysis of questionnaires (from Regional Training Course, 2006) based on 5 marks system showed that practically the attendees are satisfied with the content of programmes (average mark 4.87 of 5.0), conformity to expectations (4.6 of 5.0), social-psychological aspects (4.2 of 5.0), and with the course administration (4.95 of 5.0).

Efficiency of the training course was carefully analysed using the structural adaptation of educational process as well as factors, which have influence on the quality of education. Social-psychological aspects were also taken into account in assessment of the overall efficiency. . It can be concluded that the efficiency of training depends not only on the qualification of instructors and methodological factors but also on the interaction with stakeholders and the administration. The perception of training material also, depends on motivation to education, background knowledge, age and working experience, social status (work status) and on the degree of homogeneity of group.

A number of analytical methods for improving of training programmes and activities were utilised such as Ishikawa's diagram method and Pareto's principle (or the 80/20 Rule) [5].

Since the IETC staff has official duties (information, communication, documentation, modernisation and others) every working day, an interim team is formed during period of the training activity. IETC functions and interactions between members of this team are shown in Figure 4.

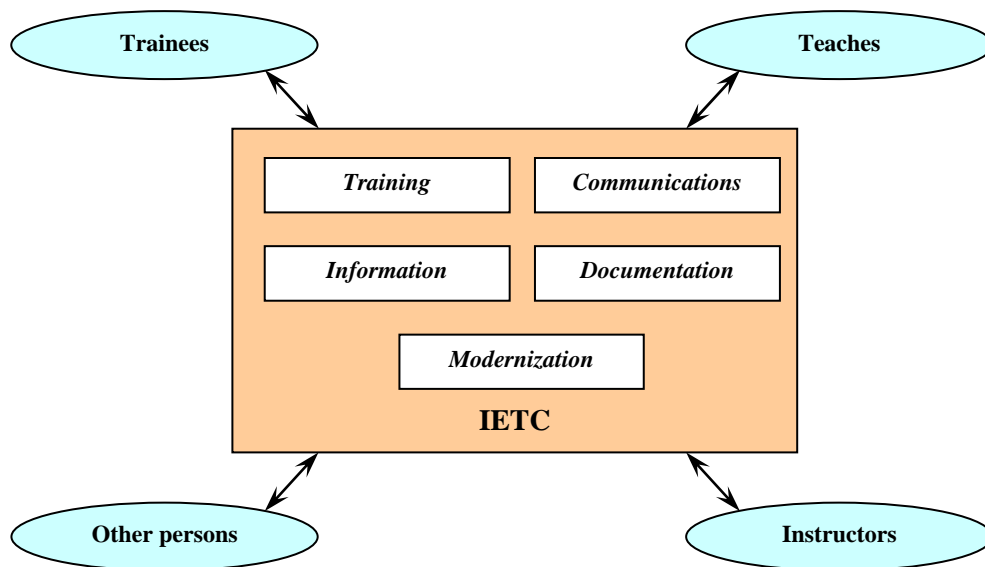


Fig. 4. Interactions between participants of training process.

CONCLUSION

This paper summarizes the current experience of the SIA "Radon" in the organisation of the IAEA sponsored training events and outlines some strategic educational elements which IETC will continue to pursue in the coming years.

The IETC at Moscow SIA "Radon" is readily available to provide assistance in cooperation in knowledge transfer from the skilled experts to the young specialist. The major advantages of the training in RADON are:

- a) Training can be organized on the most aspects of L&ILW pre-disposal waste management at one place;
- b) The training programs can be in the fundamental research, applied research and in practical operational areas,
- c) The training facilities are modern, new and well equipped to support the training;

REFERENCES

1. Sobolev I.A., Dmitriev S.A., Barinov A.S., Polsky O.G., Turlak E.A., Ojovan M.I. Management of radioactive waste generated out of nuclear fuel cycle. *At. Energ.*, **79**, 437-443 (1995). <http://www.radon.ru.htm> .
2. Batyukhnova, O.G., Ozhovan, M.I., Sobolev, I.A., Dmitriev, S.A., Timofeev, E.M., Puzanov, Yu.V., Golubtsov, I.V., Arustamov, A.E., Agrinenko, V.V. Improvement of the System for Training Specialists in Radioactive Waste Management. *At. Energ.*, **86**, 151-153 (1999). <http://www.radon.ru/iaea/center.htm>
3. Batyukhnova O.G., Ojovan M.I., Sobolev I.A, Dmitriev S.A. Improving the Education System of Specialists in the Radioactive Waste Management, *Proc. WM'99*, Tucson, Arizona (1999), CD-ROM.
4. Sobolev I.A., Dmitriev S.A., Batyukhnova, Ojovan M.I., Tscherbatova T.D., Arustamov A.E. Problems and Tasks of Training at Courses for Enhancement of Qualification in the Radioactive Waste Management Area, *Proc. WM'02*, Tucson, Arizona (2002), CD-ROM.
5. Batyukhnova O.G., Dmitriev S.A., Ojovan M.I., Agrinenko V.V., Sabol J., Efremenkov V.M. Russian-IAEA Education Training Centre at Moscow SIA «Radon»: 8 Years Experience in Educating Personnel to Manage Radioactive Wastes. *Proc. WM'06*, Tucson, Arizona (2006) CD-ROM.
6. Batyukhnova O.G., Dmitriev S.A., Puzanov Yu.V., Semenova I.V., Ojovan M.I. Quantitative Assessment Personnel Training Efficiency in Management of Radioactive Waste. *Proc. WM'06*, Tucson, Arizona (2006) CD-ROM.
7. Guidebook on Training to Establish and Maintain the Qualification and Competence of Nuclear Power Plant Operations Personnel. *TECDOC 525*, Rev.1 (1994) Vienna: IAEA, Vienna.
8. Nuclear Power Plant Personnel Training and its Evaluation, a guidebook, *TRS 380* (1996) IAEA, Vienna.
9. Ojovan M.I., Timofeev E.M., Batyukhnova O.G., et al. System approach to training the personnel in the area of the radioactive waste management. - 3-rd International Conference "Radioactive safety": Radioactive materials transportation. *Atomtrans - 2000*, S-Pt., October 31 - November 4, 309-310, (2000).
10. Nuclear Technology Education Consortium. <http://www.ntec.ac.uk/intro.htm>